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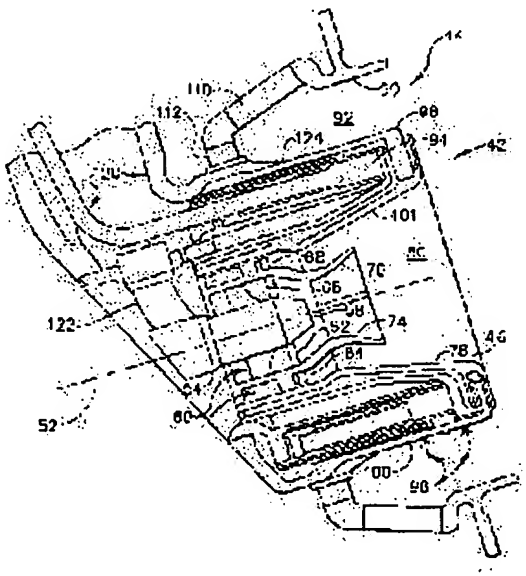
(54) METHOD FOR OPERATING GAS TURBINE ENGINE, COMBUSTION DEVICE AND MIXER ASSEMBLY

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a combustion device (16) operating with high combustion efficiency and low emission of carbon monoxide, nitrogen oxide and exhaust gas upon low output and high output operations.
SOLUTION: The combustion device includes a mixer assembly (41) having a pilot mixer (42) and a main mixer (44). The pilot mixer includes a pilot fuel injector (58), at least one swirling device (60) and an air splitter (70). The main mixer extends on the periphery of the pilot mixer and includes a plurality of fuel injection ports (98) and a conical air swirling device (110) located upstream the fuel injection ports (98). Upon idling output operation of an engine, the pilot mixer is aerodynamically separated from the main mixer and only air is supplied to the main mixer. Upon high output operation, fuel is also supplied to the main mixer. The conical swirling device of the main mixer accelerates the radial and circumferential mixture of fuel and air.



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CLAIMS

[Claim(s)]
[Claim 1] A pilot mixer equipped with a pilot fuel nozzle (54) and two or more AKISHIARU swirlers (60) (42), So that reduction of the amount of emission from the combustor (16) containing a mixer assembly (41) equipped with the main mixer (44) equipped with the main swirler and two or more fuel-injection ports (98) may be promoted The phase where are the approach of operating a gas turbine engine (10), and this fuel is breathed out by the lower stream of a river of the AKISHIARU swirler of said pilot mixer, and injects a fuel in said combustor through said pilot mixer, The approach characterized by including the phase of being revolved by at least one of a conical swirler (110) and cyclone swirlers (210) before this airstream is breathed out from said main mixer, and drawing airstream into said combustor through said main mixer.
[Claim 2] Said phase of drawing airstream into said combustor is an approach according to claim 1 characterized by including further the phase which injects a fuel outward [radial] from the annular fuel manifold (94) arranged between said main mixers (44) and said pilot mixers (42).
[Claim 3] Said phase of drawing airstream into said combustor (16) is an approach according to claim 1 characterized by including further the phase of making it circling in airstream inside said main mixer (44) with an AKISHIARU swirler (112) before making it circle in airstream by at least one of said conical swirler (110) and cyclone swirlers (210).

[Claim 4] At least one of the conical swirler (110) of said main mixer and the cyclone swirlers (210) of the main mixer Said phase of the swirler of the 1st group and the swirler of the 2nd group being included, and drawing airstream into said combustor (16) The approach according to claim 1 characterized by including further the phase of drawing airstream through said main mixer (44) so that it may be made circling in the one section of airstream by the swirler of said 1st group and may be made circling in the one section of airstream by said 2nd swirler.
[Claim 5] Said phase of drawing airstream through said main mixer (44) so that it may be made circling in the one section of airstream is an approach according to claim 4 characterized by including further the phase of making it circling in the specific direction in airstream by the swirler of said 1st and 2nd groups.
[Claim 6] Said phase of drawing airstream through said main mixer (44) so that it may be made circling in the one section of airstream is an approach according to claim 4 characterized by including further the phase of making it circling in the 1st direction in airstream in the 2nd direction of said 1st direction and opposite direction by the swirler of said 2nd group again, by the swirler of said 1st group.
[Claim 7] Gas turbine engine (10) It is the combustor (16) of **. Air splitter (70), Two or more AKISHIARU air swirlers (60) located in the upstream of a pilot fuel nozzle (54) and this pilot fuel nozzle are included. Said air splitter is located in the lower stream of a river of said pilot fuel nozzle, and said air swirler is located in the radial outside of said pilot fuel nozzle, and are attached in this alignment to said pilot fuel nozzle. The main mixer (44) which is located in the radial outside of a pilot mixer (42) and this pilot mixer, and is adjusted by this alignment to this pilot mixer is included. This main mixer Two or more fuel-injection ports (98) and a swirler equipped with at least one of a conical air swirler (110) and cyclone air swirlers (210) are included. The swirler of said main mixer is a combustor characterized by what is located in the upstream of the fuel-injection port of said main mixer (16).
[Claim 8] It is the combustor according to claim 7 which this fuel manifold includes the radial inside front face and the radial outside front face (100), including further a fuel manifold (94) annular between said pilot mixers (42) and said main mixers (44), and is characterized by constituting the fuel-injection port (98) of said main mixer so that a fuel may be injected outward [radial] from the radial outside front face of said fuel manifold (16).
[Claim 9] Said main mixer (44) is a combustor according to claim 7 characterized by including an AKISHIARU swirler (112) further (16).
[Claim 10] The AKISHIARU swirler of said main mixer is a combustor according to claim 9 characterized by being

located in at least one upstream in said conical air swirler (110) and said cyclone air swirler (210) (16).
[Claim 11] It is the combustor according to claim 7 which at least one of said conical air swirler (110) and cyclone air swirlers (210) contains the 1st swirler and 2nd swirler, said 1st swirler is constituted so that it may be made to circle in the 1st direction in air, and is characterized by constituting said 2nd swirler so that it may be made to circle in the 2nd direction in air (16).
[Claim 12] The 1st direction by said 1st swirler is a combustor according to claim 11 characterized by being the 2nd direction and opposite direction by said 2nd swirler (16).
[Claim 13] The 1st direction by said 1st swirler is a combustor according to claim 11 characterized by being the same direction as the 2nd direction by said 2nd swirler (16).
[Claim 14] It is the mixer assembly (41) for the combustors (16) of a gas turbine engine constituted so that the emission from a combustor may be controlled. A pilot mixer (42) and the main mixer (44) are included. Said pilot mixer And two or more AKISHIARU swirlers (60) located in a radial outside are included. the upstream of a pilot fuel nozzle (54) and this pilot fuel nozzle -- said main mixer And it is located in this alignment to it. the radial outside of said pilot mixer -- said main mixer The swirler of said main mixer is a mixer assembly characterized by including at least one of the conical main swirler (110) and cyclone swirlers (210) including the swirler located in the upstream of two or more fuel-injection ports (98) and this fuel-injection port (41).
[Claim 15] The fuel-injection port (98) of said main mixer is a mixer assembly according to claim 14 characterized by being constituted so that a fuel may be injected outward [radial] from said annular fuel manifold, including further a fuel manifold (94) annular between said pilot mixers (42) and said main mixers (44) (41).
[Claim 16] The main mixer (44) of said mixer assembly is a mixer assembly according to claim 15 characterized by including an AKISHIARU swirler (112) further (41).
[Claim 17] The AKISHIARU swirler (112) of the main mixer of said mixer assembly is a mixer assembly according to claim 16 characterized by being located in at least one upstream in said conical main swirler (110) and a cyclone swirler (210) (41).
[Claim 18] At least one of the conical main swirler (110) of said main mixer (44) and cyclone air swirlers (210) is the mixer assembly according to claim 15 characterized by including two or more swirlers (41).
[Claim 19] Two or more swirlers of said main mixer are mixer assemblies according to claim 18 characterized by including the 1st swirler constituted so that it may be made to circle in the 1st direction in air, and the 2nd swirler constituted so that it may be made to circle in the 2nd direction of the 1st direction by said 1st swirler, and an opposite direction in air (41).
[Claim 20] Two or more swirlers of said main mixer are mixer assemblies according to claim 18 characterized by including the 1st swirler constituted so that it may be made to circle in the 1st direction in air, and the 2nd swirler constituted so that it may be made to circle in the 2nd direction of the same direction as the 1st direction by said 1st swirler in air (41).

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] Generally more specifically, this application is related with a gas turbine combustor about a combustor.
[0002]
[Description of the Prior Art] Also domestically according to the air pollution problem in the whole world, international more severe blowdown (emission) criteria will be introduced as a result. The aircraft is managed by the criteria of both Environmental Protection Agency (EPA) and the International Civil Aviation Organization (ICAO). These criteria regulate the emission of the nitrogen oxides (NOx) from the aircraft near [used as the cause of city photochemical smog] an airport, a non-burned hydrocarbon (HC), and a carbon monoxide (CO). Generally, engine emission is divided into two categories of what (NOx) is generated for high flame temperature, and the thing (HC and CO) generated for the low flame temperature which cannot perform the reaction of a fuel and air thoroughly.
[0003] Some [at least] known gas turbine combustors mix high-speed air with the detailed fuel spray including ten pieces thru/or 30 mixers. These mixers consist of the single fuel injector usually installed in the core of a swirler, and a swirler makes it circle in acceptance air, and raises flame holding and mixing. Both a fuel injector and a mixer are installed in a combustor dome.
[0004] Generally, the ratio (fuel-air ratio) of a fuel to the air in a mixer is thick (rich). Since the overall fuel-air ratio of a gas turbine combustor is rarefaction (Lean), before flowing out of a combustor, additional air is added through each dilution hole. in a dome, both a mixed defect and a hot spot may happen, and the injected fuel is evaporated in advance of combustion -- making -- it is necessary to mix -- moreover, the dome where air is [near a dilution hole] rich -- it is added by gaseous mixture.
[0005] Since one state of the art Lean style dome combustor contains two mixers accumulated radially in each fuel nozzle which is visible to two annular rings when it sees from the transverse plane of a combustor, it is called a double annular combustor (DAC). It has come to be able to perform adjustment to operation in the condition of differing, with the mixer of an additional train. At the time of an idling, a fuel is supplied to an outside mixer, and it is designed so that it can operate efficiently in the state of an idling. At the time of high power operation, most fuels are supplied to both mixers and air is supplied to inside annular space, and it is designed so that it can operate in the condition that there is moreover almost no emission most efficiently at the time of high power operation. Although the mixer has so far been adjusted so that it may become the optimal actuation by each dome, over the field where the interface between domes is large, inflammation will be reduced and that will make [more] CO reaction than the rich type dome single annular combustor (SAC) of resemblance by CO in these designs. Such a combustor is the product of compromise to the emission at the time of low-power output, and NOx at the time of high power.
[0006]
[Problem(s) to be Solved by the Invention] Other known combustors operate as a Lean style dome combustor. A pilot wave and the main phase are divided into a separate dome, and it replaces with producing remarkable CO resolution area in an interface, and although a mixer is this alignment, it includes the main airstream in the interior of equipment with a pilot wave separately. However, since in many cases CO/HC emission will increase if mixing of fuel/air is raised, it is difficult to control simultaneously CO/HC and flue gas emission at the time of low-power output by such design. The main air which circles tends to draw a pilot flame essentially, and tends to make it reduce inflammation. In order to prevent that the fuel spray is drawn into the main air, a pilot wave constitutes the narrow angle fuel spray. By this, a long jet flame peculiar to the flow of the number of turning small as a result will be produced. This pilot flame generates high flue gas, a carbon monoxide, and hydrocarbon emission, and is inferior in stability.

[0007]
[Means for Solving the Problem] Moreover in an instantiation operation gestalt, the combustor for gas turbine engines operates by the low carbon monoxide, nitrogen oxides, and flue gas emission with high combustion efficiency at the time of engine low-power output, a medium output, and high power operation. A combustor contains the mixer assembly containing a pilot mixer and the main mixer. A pilot mixer contains a pilot fuel injector, at least one swirler, and an air splitter. The main mixer is prolonged around the pilot mixer in the hoop direction, and contains the conical air swirler located in the upstream of two or more fuel-injection ports and a fuel-injection port.
[0008] At the time of idling output operation of an engine, since a pilot mixer is aerodynamically separated from the main mixer, only air is supplied to the main mixer. At the time of high output operation, a fuel is also supplied to the main mixer, and the conical (cone) swirler of the main mixer promotes mixing of the fuel and air of radial and a hoop direction, and brings about distribution of an almost uniform fuel and air for combustion. More specifically, the airstream which flows out of the main mixer swirler mixes compulsorily with airstream the fuel injected in the main mixer outward [radial] from the fuel-injection port. consequently, a fuel and air -- gaseous mixture is distributed to homogeneity inside a combustor, and promotes the perfect combustion inside a combustor, therefore decreases the nitrogen-oxides emission at the time of high power operation.
[0009]
[Embodiment of the Invention] Drawing 1 is the schematic diagram of the gas turbine engine 10 containing a low pressure compressor 12, a high pressure compressor 14, and a combustor 16. An engine 10 contains a high pressure turbine 18 and a low pressure turbine 20 again.
[0010] Air flows through a low pressure compressor 12 during operation, and the pressurized air is supplied to a high pressure compressor 14 from a low pressure compressor 12. The air pressurized by altitude is sent into a combustor 16. The airstream (not shown in drawing 1) from a combustor 16 drives turbines 18 and 20.
[0011] Drawing 2 is the sectional view of the combustor 16 used for the engine 10 shown in drawing 1 , and a similar gas turbine engine, and drawing 3 is the enlarged drawing of the combustor 16 along a field 3. Setting in one operation gestalt, a gas turbine engine is CFM. It is an available CFM mold engine from International. It is General which a gas turbine engine has in Ohio Cincinnati in another operation gestalt. Electric It is available GE90 mold engine from Company.
[0012] Each combustor 16 includes, the combustion area 30, i.e., the combustion chamber, formed of the annular radial outside liner 32 and the radial inside liner 34. The outside liner 32 forms the outside interface of a combustion chamber 30, and, more specifically, the inside liner 34 forms the inside interface of a combustion chamber 30. Liners 32 and 34 are located in the radial inside from the annular combustor casing 36 prolonged around liners 32 and 34 in a hoop direction.
[0013] A combustor 16 includes the annular dome 40 attached in the upstream of the outside liner 32 and the inside liner 34, respectively again. The upper edge of a combustion chamber 30 is formed, and around a dome 40, the mixer assembly 41 keeps spacing in a hoop direction, is arranged, and a dome 40 supplies the gaseous mixture of a fuel and air to a combustion chamber 30.
[0014] Each mixer assembly 41 contains the pilot mixer 42 and the main mixer 44. The pilot mixer 42 contains the annular pilot housing 46 which forms a chamber 50. The chamber 50 has the symmetry axis 52 and is the configuration of a cylindrical shape mostly. The pilot fuel nozzle 54 is prolonged in a chamber 50, and is symmetrically attached to a symmetry axis 52. A nozzle 54 contains the fuel injector 58 for supplying the globule of a fuel into the pilot chamber 50. In one operation gestalt, the pilot fuel injector 58 supplies a fuel through an injection exhaust nozzle (not shown). In another operation gestalt, the pilot fuel injector 58 supplies a fuel with a simplex injection spray (not shown).
[0015] The pilot mixer 42 contains the swirler 60 attached in this alignment of a couple again. A swirler 60 is an AKISHIARU (shaft) swirler and, more specifically, contains the pilot inside swirler 62 and the pilot outside swirler 64. The pilot inside swirler 62 is annular and is arranged around the pilot fuel injector 58 in a hoop direction. Each swirlers 62 and 64 contain two or more aerofoils 66 and 68 arranged for the upstream of the pilot fuel injector 58, respectively. Aerofoils 66 and 68 are chosen so that a desired ignition quality, the Lean stability, a low carbon monoxide (CO), and hydrocarbon (HC) emission may moreover be obtained at the time of low-power output operation of an engine.
[0016] The pilot splitter 70 is located between radial [of the pilot inside swirler 62 and the pilot outside swirler 64], and is prolonged on the lower stream of a river of the pilot inside swirler 62 and the pilot outside swirler 64. The pilot splitter 70 is annular, it extends around the pilot inside swirler 62 in a hoop direction, and, more specifically, the airstream which moves through the inside swirler 62 is separated from the airstream which flows through the outside swirler 64. A splitter 70 has Sai's inside front face 74, while producing the thin film front face of a fuel at the time of low-power output operation of an engine. A splitter 70 decreases the shaft-orientations rate of the air which flows

through the pilot mixer 42 again, and makes the recirculation of elevated-temperature gas possible.
[0017] The pilot outside swirler 64 is located in the radial outside of the pilot inside swirler 62, and is located in the radial inside on the front face 78 of the inside of the pilot housing 46. The pilot outside swirler 64 is prolonged around the pilot inside swirler 62 in a hoop direction, and, more specifically, is located between radial [of the pilot splitter 70 and the pilot housing 46]. The pilot inside swirler 66 makes it circle in the same direction as the air which flows through the pilot outside swirler 68 in the air which flows through it in one operation gestalt. The pilot inside swirler 66 makes it circle in the 1st direction of the 2nd direction which makes it circle in the air to which the pilot outside swirler 68 flows the air which flows through it through it, and an opposite direction in another operation gestalt.
[0018] The main mixer 44 contains the annular main housing 90 which forms the annular cavity 92. The main mixer 44 is adjusted by this alignment to the pilot mixer 42, and is prolonged around the pilot mixer 42 in a hoop direction. A fuel manifold 94 is prolonged between the pilot mixer 42 and the main mixer 44. More specifically, a fuel manifold 94 contains the annular housing 96 which is prolonged around the pilot mixer 42 in a hoop direction, and is located between the pilot housing 46 and the main housing 90.
[0019] A fuel manifold 94 is formed in the outside front face 100 of a fuel manifold, and includes two or more injection ports 98 for injecting a fuel outward [radial] all over the main mixer cavity 92 from a fuel manifold 94. The fuel-injection port 98 promotes mixing of the fuel and air of the hoop direction in the interior of the main mixer 44.
[0020] In one operation gestalt, a manifold 94 includes the 1st train of 20 injection ports 98 which kept spacing in the hoop direction and have been arranged, and the 2nd train of 20 injection ports 98 which kept spacing in the hoop direction and have been arranged. In another operation gestalt, a manifold 94 includes two or more injection ports 98 which are not arranged by the train which kept spacing in the hoop direction. The location of the injection port 98 adjusts the degree of mixing of a fuel and air, and it is chosen so that low nitrogen-oxides (NOx) emission may be attained and may carry out perfect combustion certainly in the state of the changing engine operation. Furthermore, an injection port location is chosen so that it may help to decrease or prevent the instability of combustion again.
[0021] The annular housing 96 of a fuel manifold separates the pilot mixer 42 and the main mixer 44. Therefore, the pilot mixer 42 is protected from the main mixer 44 during pilot actuation, improves pilot engine-performance stability and effectiveness, and also promotes reduction of CO and HC emission simultaneously. Furthermore, pilot housing 46 is made into a configuration which promotes that the pilot fuel injected in the combustor 16 burns completely. More specifically, the inside wall surface 101 of the pilot housing 46 is Sai's front face, while helping to control diffusion and mixing into the airstream which flows out of the main mixer 44 of a pilot flame. Therefore, the distance between the pilot mixer 42 and the main mixer 44 is chosen so that it may help to improve an ignition quality, high power, the combustion stability at the time of low-power output operation, and the emission generated in low-power output operational status.
[0022] The main mixer 44 contains the 1st swirler 110 and 2nd swirler 112 with which each was installed in the upstream of the fuel-injection port 98 again. The 1st swirler 110 is a conical (cone) swirler, and the airstream which flows through it is breathed out at a conical swirler include angle (not shown). A conical swirler include angle is chosen so that a comparatively low sense momentum within radial may be given to the airstream breathed out from the 1st swirler 110, and it helps for this to improve mixing of the radial fuel and air of the fuel injected outward [radial] from the injection port 98. The 1st swirler 110 is divided into the swirler (not shown) which became the pair which can rotate in the same direction in a revolution or an opposite direction in another operation gestalt.
[0023] It is the AKISHIARU (shaft) swirler which helps for the 2nd swirler 112 to breathe out air in the direction almost parallel to the symmetry axis 52 of a main mixer, and to raise mixing of the fuel and air of the main mixer. In one operation gestalt, the main mixer 44 does not contain the 2nd swirler 112 only including the 1st swirler 110.
[0024] A fuel supply system 120 supplies a fuel to a combustor 16, and includes the pilot fuel circuit 122 and the main-fuel circuit 124. A fuel is supplied to the pilot fuel injector 58, and the main-fuel circuit 124 supplies a fuel to the main mixer 44, and the pilot fuel circuit 122 includes the fuel stage where the plurality used for controlling the nitrogen-oxides emission generated inside a combustor 16 became independent.
[0025] If a gas turbine engine 10 starts and it is operated by idling operational status on the occasion of operation, a fuel and air will be supplied to a combustor 16. In the idling operational status of a gas turbine, only the pilot mixer 42 is used for a combustor 16 for actuation. The pilot fuel circuit 122 injects a fuel to a combustor 16 through the pilot fuel injector 58. Simultaneously, airstream flows into the main mixer swirlers 110 and 112 at pilot swirler 60 list. Pilot airstream flows mostly to the symmetry axis 52 of a main mixer at parallel, runs against the pilot splitter 70, and draws the pilot airstream to which the pilot splitter 70 is circling in the direction of the fuel which flows out of the pilot fuel injector 58. Pilot airstream stabilizes a fuel instead and is atomized without collapsing the injection pattern (not shown) from the pilot fuel injector 58. The airstream breathed out through the main mixer 44 flows all over a combustion

chamber 30.
[0026] If only a pilot fuel stage is used, it will enable it for a combustor 16 to maintain low-power output operation effectiveness, to control the emission discharged from a combustor 16, and to make it the minimum. Since it dissociates from the main mixer airstream, a pilot fuel is lit thoroughly, and burns and, as a result, pilot airstream brings about emission at the time of the low-power output of the Lean stability, a low carbon monoxide, a hydrocarbon, and nitrogen oxides.
[0027] If a gas turbine engine 10 is accelerated by high power operational status from idling operational status, an additional fuel and air will be introduced into a combustor 16. In high power operational status, in addition to a pilot fuel stage, a fuel is supplied to the main mixer 44 by the main-fuel circuit 124, and it is injected outward [radial] by the fuel-injection port 98. The swirlers 110 and 112 of the main mixer promote mixing of the fuel and air of radial and a hoop direction, and bring about distribution of an almost uniform fuel and air for combustion. more specifically, the airstream which flows out of the main mixer swirlers 110 and 112 pierces through the main mixer cavity 92 -- as -- a fuel -- compulsory -- radial outwardness -- extending -- mixing of a fuel and air -- promoting -- Lean main mixer [44] air and a fuel -- it makes it possible to operate by gaseous mixture. in addition, a fuel and air -- by distributing gaseous mixture to homogeneity, perfect combustion is obtained and reduction of the NOx emission at the time of high power operation is promoted.
[0028] Drawing 4 is the sectional view of another operation gestalt of the combustor 200 which can be used for a gas turbine engine 10. The combustor 200 is mostly similar to the combustor 16 shown in drawing 2 and drawing 3 , and specifies the component part of a combustor 16, and the component part in the same combustor 200 by drawing 4 using the same reference mark as having used by drawing 2 and drawing 3 . Although a combustor contains the pilot mixer 42 and the annular housing 96 of a fuel manifold, more specifically, it does not contain the main mixer 44. A combustor 200 rather contains the almost same main mixer 202 as the main mixer 44 (shown in drawing 2 and drawing 3).
[0029] The main mixer 202 contains the annular main housing 204 which forms the annular cavity 206. The main mixer 202 is adjusted by this alignment to the pilot mixer 42, and is prolonged around the pilot mixer 42 in a hoop direction. A fuel manifold 94 is prolonged between the pilot mixer 42 and the main mixer 202.
[0030] The main mixer 202 contains the 1st swirler 210 and 2nd swirler 112 with which each was installed in the upstream of the fuel-injection port 98 again. The 1st swirler 210 is a cyclone swirler, and is an AKISHIARU (shaft) swirler which helps for the 2nd swirler 112 to breathe out air in the direction almost parallel to the symmetry axis 52 of a main mixer, and to raise mixing of the fuel and air of the main mixer. The 1st swirler 210 is divided into the swirler (not shown) which became the pair which can rotate in the same direction in a revolution or an opposite direction in another operation gestalt.
[0031] An above-mentioned combustor has dependability with it. [good and cost effectiveness and] [high] A combustor contains a mixer assembly equipped with a pilot mixer and the main mixer. A pilot mixer is used at the time of low-power output operation, and the main mixer is used at the time of medium and high power operation. Between idling operational status, a combustor operates by low emission and only air is supplied to the main mixer. Between high power operational status, a combustor supplies a fuel also to the main mixer and the main mixer contains the conical (cone) swirler for improving mixing of the fuel and air of the main mixer. a conical swirler -- a fuel and air -- it helps to distribute gaseous mixture to homogeneity, and to improve the combustion inside a combustor, and to reduce the whole flame temperature. By operating temperature falling and combustion being improved, the improvement in actuation effectiveness and the reduction of combustor emission at the time of high power operation are promoted. Consequently, moreover, a combustor operates by the low carbon monoxide, nitrogen oxides, and flue gas emission with high combustion efficiency.
[0032] Although this invention has been explained about various specific operation gestalten, probably, it will be clear to this contractor this invention's for it to be able to carry out with the technical thought of a claim and the deformation gestalt of technical within the limits. the sign indicated by the claim -- an understanding -- it is because it is easy and the technical range of invention is not ****(ed) in the example at all.

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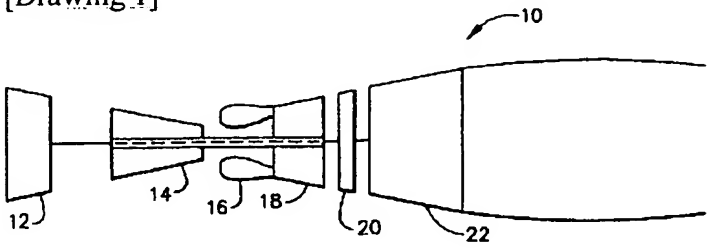
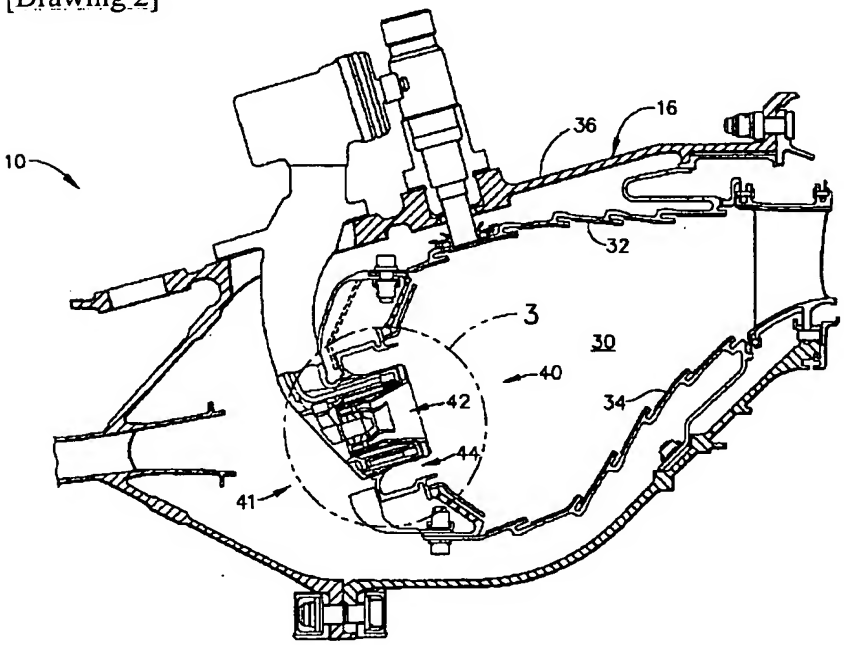
DRAWINGS

[Drawing 1]



[Drawing 2]



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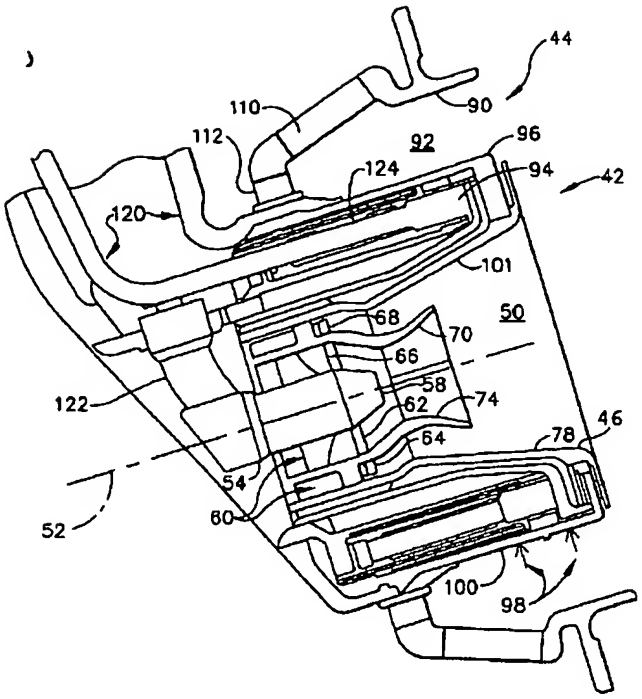
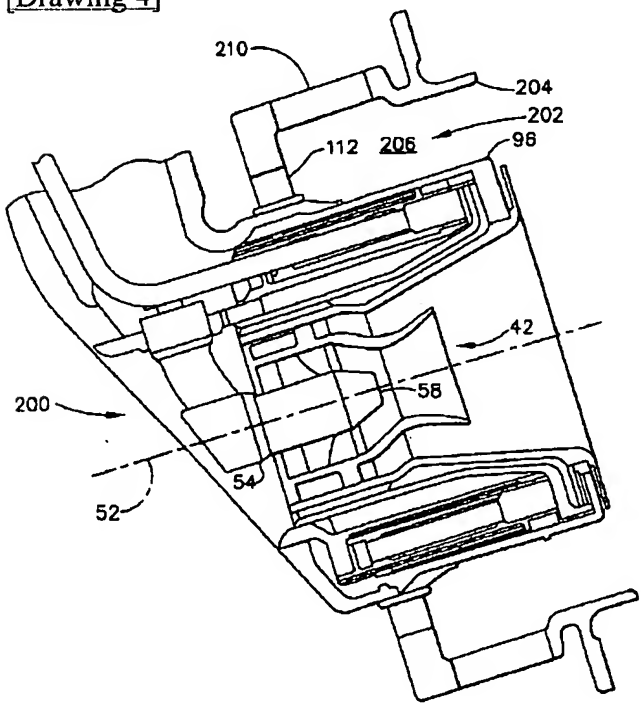


[Drawing 4]



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